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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/560,555	04/28/2000	David L. Stephenson	15-4-910.00	3306

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EXAMINER

GROSS, KENNETH A

ART UNIT

PAPER NUMBER

2122

DATE MAILED: 08/22/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/560,555

Applicant(s)

STEPHENSON ET AL.

Examiner

Kenneth A Gross

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other:

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: In the section titled “*Frequency Values*”, applicant explains that the frequency values are stored as 64-bit float values (page 14, lines 19-20). In the next paragraph, however, applicant states that EXACT and GUESS, two frequency variables, are stored as “32-float values.” (pages 14, 15, lines 26, 1) This is unclear for two reasons. First, “32-float” is understood to mean “32-bit float”, however this needs to be explicitly stated. Second, EXACT and GUESS were already stated in the preceding paragraph to be frequency values stored as 64-bit floats.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claim 1 rejected under 35 U.S.C. 102(b) as being anticipated by Buzbee (U.S. Patent No. 5,815,720).

Buzbee teaches the following: (1) accessing the first intermediate representation of source code with instrumented instructions. “Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling

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code to be placed within the second object code and thus to determine the profile information which will be generated.” (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (3) Updating feedback data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator generates profile information based on annotations; (4) Optimizing intermediate code using feedback data. “Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The “process may be repeated to generate additional profile information about the optimized object code to further optimize object code for the application.” (Column 2, lines 16-18)

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Chaitin (U.S. Patent No. 4,656,582).

Buzbee does not specify if dead code elimination, dead store elimination, branch elimination, or code transformation optimizations are performed. However, the Chaitin reference teaches a method of optimizing compiled code using dead code elimination. (Column 9, line 40)

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Chaitin calls dead code elimination a “standard technique.” Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the method uses dead code elimination, since it is a standard and beneficial technique for optimization.

6. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Robert Morgan, “Building an Optimizing Compiler” (hereinafter Morgan).

Buzbee does not mention that the second source code (or intermediate representation) should be represented a tree corresponding to procedures within the source code. However, Morgan teaches in Chapter 4, Section 1 (page 94) that “Optimizing compilers use a range of different data structures to represent procedures being compiled...the procedure may be represented as a tree...it is natural to represent the procedure as a tree.” See abstract syntax trees in Section 4.1 for representing procedures. Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parsed data.

7. Claims 4, 5, and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Robert Morgan, “Building an Optimizing Compiler” (hereinafter Morgan) and further in view of Larus (U.S. Patent Number 6,327,699).

With respect to claim 4, as applied to Claim 3 above, the combination of Buzbee and Morgan does not teach the conversion from a tree to a control flow graph and the annotation of frequency values to said control graph as described by applicant in Claim 4. However, the Larus reference does teach the conversion of a program into a control flow graph, which profiles the entire path of a program. Larus describes a method that instruments a program with code and then executes the program in order to trace the entire path of the program. Furthermore, Larus teaches that the control flow graph would collect metrics as it profiles the program path, one such metric being the frequency of the execution of a program path. (Claims 1, 6, 7 of Larus) Since it is beneficial to represent source code as a tree, it would have been apparent to convert a tree into a control flow diagram, deriving the benefits from the tree representation. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to construct an optimizing compiler taught by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parse data. It would then be obvious to convert this tree into a control flow graph as taught by Larus and then run a plurality of sample executions on the code, collecting frequency information as taught by Larus, since this is a more beneficial method for collecting frequency information.

With respect to Claim 5, Buzbee teaches that his translator generates profile information by “associating counters with the branches (arc counting)” or with “code representing each line.” (Column 7, lines 1-3) These counter values, being precise measurements, can be classified as EXACT values. Therefore, it is obvious to one with ordinary skill in the art at the time of the invention to use a source code optimizing compiler described by Buzbee with a tree

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representation of the intermediate code. It is further obvious to construct a flow graph from this tree, giving counter values to the arcs of said flow graph, and labeling these counter values as EXACT, since they represent the exact number of times certain portions of code have been executed.

With respect to Claim 8, it was taught above that it is beneficial to convert a tree representation of code into a flow chart diagram for easier collection of frequency data. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a computer program product as described by Buzbee to perform optimizations, with a product means of constructing a flow graph from a tree representation of code and collecting frequency information from said flow graph, in order to implement the method of construction and frequency collection already shown to be beneficial.

8. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720).

Buzbee teaches the following: A computer system with (1) means for computer access to intermediate representation of source code with instrumented instructions. "A computer system comprising: a translator which translates first object code of a high-level language program to a second object code (Column 10, lines 1-4)...a compiler which compiles source code to generate first object code (Column 10, lines 15-18)...a computing system as in claim 12 wherein the compiler places annotations in the first object code (Column 10, lines 26-27)...the translator utilizes the annotations ...to determine content of profiling code." (Column 10, lines 28-31); (2) means for annotating intermediate code with feedback data. "Means for adding profiling code

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to the second object code.” (Column 10, lines 5-6); (3) means for updating data using a propagation scheme. (Column 10, lines 5-7); (4) means for optimizing intermediate code using feedback data. (Column 10, lines 22-25).

Buzbee, however, does not teach a means for repeating the updates to the propagation data and the optimization based on this feedback data to further optimize the code. Yet Buzbee does teach the *method* of repeated executions of the optimizing compiler, citing the benefits of repeated optimizations (Column 2, lines 16-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to compile the source code multiple times using the computer system means described by Buzbee, since this would be the same as implementing a program code means for re-executing the compiler optimization function.

9. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Robert Morgan, “Building an Optimizing Compiler” (hereinafter Morgan).

As shown in paragraph number 8 above, the Buzbee reference anticipates the applicant’s claim of a computer program product for optimizing source code in Claim 6. It was also shown in paragraph number 6 that it is natural to represent code in a tree format. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a computer program product as described by Buzbee to perform optimizations where the intermediate representation of code is stored in tree format, shown to be a natural representation by Morgan, in order to derive the benefits of a tree representation.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hotta (U.S. Patent Number 5511198) teaches an optimizing compiler which translates a source program into an intermediate representation, optimizes said intermediate representation, and converting optimized intermediate representation into an optimized program.

Goebel (U.S. Patent Number 6289505) teaches the annotation of a first binary executable, the conversion of said binary executable into an intermediate representation, and optimizing the intermediate representation based on an execution profile generated from a first execution of the binary executable.

Cocke (U.S. Patent Number 4802091) teaches a procedure used in an optimizing compiler that utilizes dead code elimination for optimization.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kenneth A Gross whose telephone number is (703) 305-0542.

The examiner can normally be reached on Mon-Fri 7:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory A Morse can be reached on (703) 308-4789. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-7239 for regular communications and (703) 746-7240 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

KAG

August 20, 2002



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